OPERATIONS & SERVICE
MANUAL

TSC-901

RECORDER MANUAL

gulton®

Plotting the Future of Graphic Recording

OPERATIONS & SERVICE MANUAL

TSC-901

MEASUREMENT & CONTROL SYSTEMS DIVISION
GULTON INDUSTRIAL PARK
EAST GREENWICH, RHODE ISLAND 02818

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WARRANTY

TECHNI-RITE warrants each instrument to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose, and replacing any defective parts thereof (except pens, tubes, fuses and batteries). This warranty is effective for one year after delivery to the original purchaser, when the instrument is returned transportation charges prepaid by the original purchaser, and which, upon our examination, proves to be defective. If the defect has been caused by misuse or abnormal conditions of operation, repairs will be billed at our current rate. In this case, an estimate will be submitted before the work is started. This warranty is in lieu of all other warranties, expressed or implied.

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LIST OF ILLUSTRATIONS

	DWG.#
Schematic, Preamplifier	401064
Assembly, Preamplifier	401133
Assembly, Attenuator	401103-1
Assembly, Preamplifier	401110
Schematic, Preamplifier Module	600766

I. DESCRIPTION

A. The TSC-901 is a plug-in Signal Conditioner designed for use with Techni-Rite Recorders, which performs the dual functions of providing calibrated amplifications of signals and regulated power to the Amplifier Pen Motor located in the Recorder Main Frame. The TSC-901 can be used interchangeably with the TR9800, 9600, 9400, 9200 model recorders. The TSC-901 accepts AC and DC signal inputs up to 80 volts full scale.

B. The TSC-901 is calibrated for voltage gain of 10, which provides a nominal system sensitivity of 1 mv/chart division. The input circuit is differential, balanced with respect to frame, and provides excellent common mode rejection. Calibrated zero suppression is provided, which allows the recording of small AC signals which are superimposed upon high DC levels.

C. Specifications, TSC 901

1. Sensitivity: 1 mv/div., nominal
2. Input Configuration: 500K ohms ±2%, balanced differential with respect to Frame (may be used single ended.)
3. Linearity: ±1% of full scale (for input voltages up to ±25 mv.)
4. Attenuator Switch: a) Positions: 8 active, from 1 mv/div to 2 V/div
   b) Ratio Accuracy: ±½% typical
   c) Other Positions: OFF, Io, CAL
5. Baseline Drift: a) 0.2 div/8 hr (typical)
   b) 0.5 div/10°C (maximum)
6. Rise Time: 4 to 5 ms for 5 mm peak to peak stylus deflection typical. Limited by recorder in which used.

7. Position Adjustment: ± 27 div (Minimum)

8. Vibration: 3 g's at 2 to 100 Hz

9. Common Mode Rejection: a) Typical 60 db
   b) Minimum 48 db

10. Zero Suppression Accuracy: ±2% of dial reading

D. Specifications, TSC-901 with recorder.

1. Linearity: ±¼ div

2. Hysterisis: 0.1 div maximum

3. Calibration Voltage: Set at 200 (±½) mv
   Accuracy: ±1% for 6 months
   Minimum Adjustment: ±200 (±10) mv

4. Power Requirements: 115V ±10 VAC
   50 Hz or 60 Hz, 6 WATTS.

5. Operating Temperature Range: 0° to 50°C ambient

6. Duty Cycle: Continuous for normal operation

7. Life (MTBF): 10,000 hours minimum for normal operating conditions.

8. Io Offset: a) 0.1 Div typical
   b) 0.25 Div maximum

9. Vo Adjustment: Set to within 0.1 div, (±3 div adjustment minimum)

10. Noise: a) 0.1 div. typical
    b) 0.2 div. maximum

II. INSTALLATION

A. Mechanical

The TSC-901 plugs into the recorder main frame. To install the TSC-901, hold the module upright and align the top and bottom edges of its printed circuit card with the slots milled into the main frame, or with the nylon P.C. card guides located above the recording channel into which the module is to be inserted. Apply pressure to the left-hand edge of the module front panel and press it firmly into place until the front panel is flush with the face of the recorder. Final seating pressure may be applied to the removal handles located on the top and bottom of the front panel. (Ref: Fig. 1a and 1b)

B. Electrical

All electrical connections are made between module and recorder in A. above, including signal inputs which are routed to connections on the top rear of the recorder.

C. Signal Connection

See Figure 2: The input connector pins are numbered from 1 to 5 counterclockwise starting from the keyway. Make connections according to the table below:

INPUT	PIN NO.
NON-INVERTING (+)	1
FRAME (COMMON)	3
INVERTING (-)	2

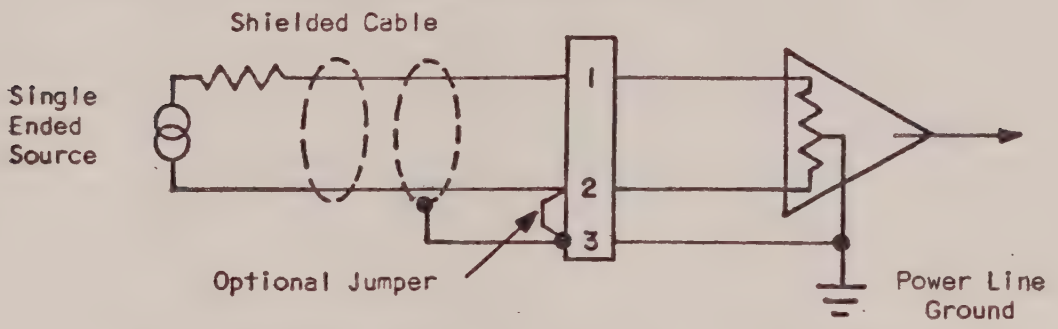
FIG. 2

a) Connect cable shield to pin 3

b) For single-ended use, connect pin 2 to pin 3

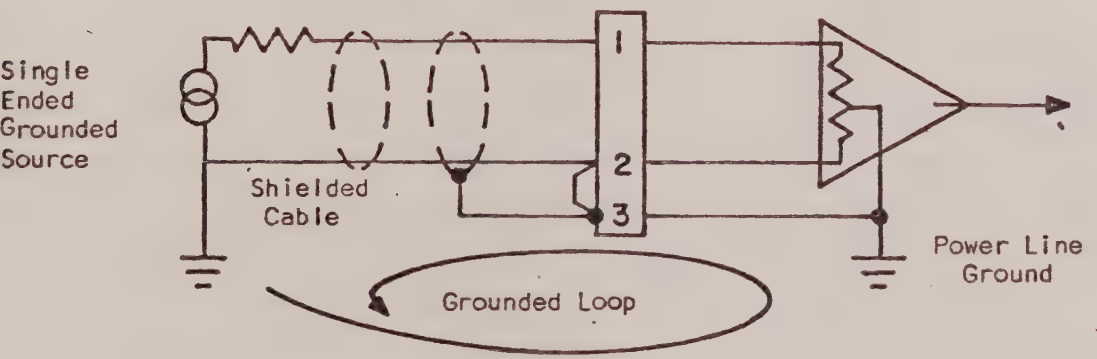
The TSC-901 has two active inputs balanced to ground. This is useful for recording outputs of both single ended and balanced sources.

Recording from a single ended source

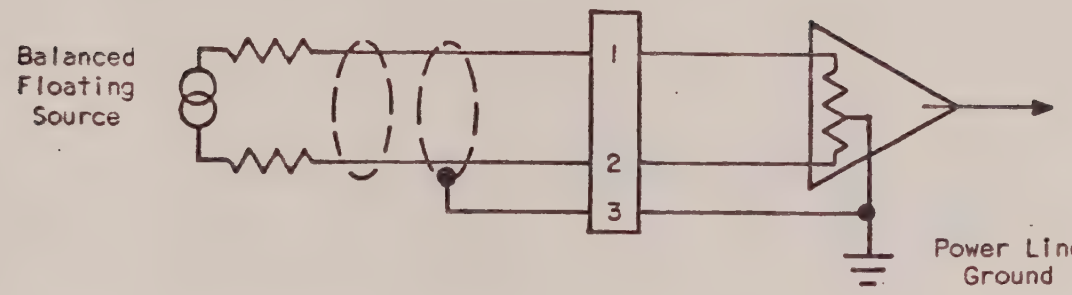


The above diagram shows cabling connections for recording from a single ended floating source. The connections can be reversed if a change in polarity is desired. The shield is connected to the grounded terminal #3. An optional grounding jumper may be installed from either input to the grounded terminal depending on which condition provides minimum electrical noise.

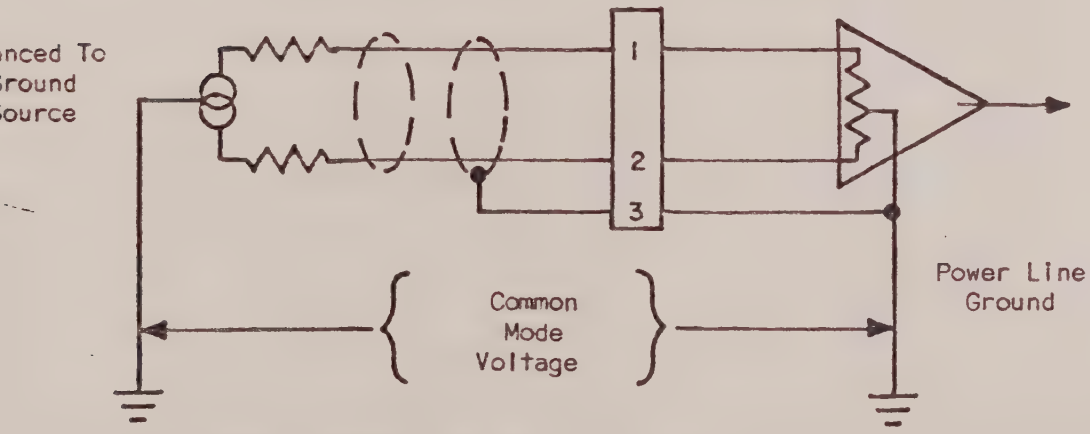
Recording from a single ended grounded source may be done as shown below but is not recommended for low level signals due to the ground loop which could add excessive electrical noise to the recorded signal.



Recording from a Balanced Source

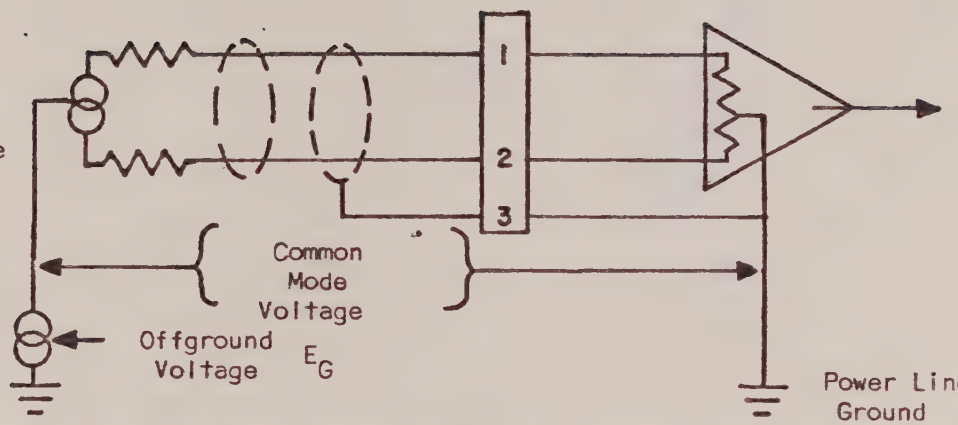


The above diagram shows cabling connections for recording from a balanced floating source.



The above diagram shows cabling connections for a balanced to ground source. The potential difference between the source ground and the recorder power line ground becomes a common mode input voltage which is largely attenuated by the amplifier.

anced
ven Off
und Source



The above diagram shows cabling connections for use with a balanced driven off-ground source. The maximum common mode voltage allowable varies with the attenuator setting. The input to the amplifier is protected by clamping diodes which limit the maximum voltage from each input to ground. At high sensitivities, 20 mv/div to 1 mv/div, the clamping diodes are the limiting factor on input voltage. At low sensitivities, 0.1 v/div to 2 v/div, the connector and wiring are the limiting factor on input voltage. The amplifier input voltage from each terminal to ground is equal to ½ the signal voltage plus the common mode voltage.

$$E_{IN\ MAX} = \tfrac{1}{2}E_S + E_G$$

The maximum input voltage is shown in the following table.

Selector Switch Setting	E_{IN} MAX $\frac{1}{2}E_S + E_G$
1 mv/div	5 volts
2 mv/div	10 volts
10 mv/div	50 volts
20 mv/div	100 volts
.1 volt/div	400 volts
.2 volt/div	400 volts
1 volt/div	400 volts
2 volt/div	400 volts

D. Input Connector Wiring

The TSC-901 requires a good quality double-conductor shielded cable, such as Belden 8451 series, for connection from the recorder to the signal source. See Recorder Manual for cable preparation instructions.

III. OPERATION & CALIBRATION

A. Set recorder main frame controls as follows:

1. Turn MAIN POWER on. Allow 15 minutes warm-up.
2. Set CHART SPEEDS switch to 1 or 5 mm/sec.
3. Adjust TRACE WDITH controls for a fine trace on all channels.

B. Calibrate TSC-901 as follows:

1. Turn round locking knobs on GAIN and POSITION controls counterclockwise 1/2 to 2/3 turn to unlock controls, then turn each locking knob clockwise until GAIN and POSITION controls are partially restrained from rotating.

2. Turn GAIN control fully counterclockwise.

3. Using position control, set trace drawn by recorder stylus precisely to the center line of its channel (directly below the signal conditioner).

4. Turn GAIN control fully clockwise. If the stylus moves from its center position by more than 2/5 of the smallest chart division, reset it to channel center line by means of the screwdriver adjustment - Vo trimmer located behind its front panel access hole marked "Vo".

5. Set function switch to Io position. Set screwdriver adjusted Io control through its identified front panel access hole for a "Null", the point at which the recorded trace most closely approaches the channel center.

6. Set function switch to CAL (calibrate) position. Set GAIN control to the position which causes the stylus to trace a line precisely 20 smallest chart divisions to the right of the channel center. NOTE: 20 divisions are <u>not</u> equivalent to the end scale deflection, which is 25 divisions.

7. Return function switch to the OFF position and verify that the stylus is tracing a line at exactly channel center. Correct if necessary, by means of the position control.

8. Repeat steps 4. and 5. until stylus traces precisely at channel center in OFF and at +20 chart divisions in the CAL positions of the function switch.

9. The signal may now be connected to the signal conditioner. The position control and range switch may now be set any position within their respective ranges of adjustment.

10. HOW TO USE ZERO SUPPRESSION:

a) Zero suppression is a calibrated 10-times full scale electrical position control at all settings of the function switch.* The purpose of 10 X full scale zero suppression is to allow expanded-scale recording of small AC signal components which are riding on top of a large DC component.

b) First record the signal to be investigated without using zero suppression. And note the approximate peak-to-peak amplitude of the AC signal component as well as that of the DC component. To save chart paper, a calibrated oscilloscope may also be used for this purpose. If the recorder itself is used for this purpose, best results will be attained by using a margin zero, that is, by initially setting the baseline of the trace at the left or right hand margin of its channel (depending upon whether the DC component is positive or negative, in that order.) Naturally, this initial setting should be made with the function switch in the OFF position.

c) Refer to the table below for suggested practical attenuator settings for various combinations of DC and AC components.

d) If a positive DC component is to be suppressed, set the zero suppress switch to "+"; for a negative component, set the switch to "-".

e) Choose and record the type of "zero" (channel center or margin) which is to be used. Set this "zero" with the POS control with function switch in OFF position. DO NOT

*practical limit: 450 volts - See table below

TOUCH POSITION CONTROL THEREAFTER, as all readings will be taken from this initial "zero".

C. ZERO SUPPRESSION TABLE

UNCTION WITCH ETTING	MULTIPLIER MV/DIV or V/DIV	EFFECTIVE FULL-SCALE SENSITIVITY (MAX AC COMPONENT)	ZERO SUPPRESSION FOR ONE FULL TURN OF Z.S.DIAL	MAXIMUM ATTAINABLE ZERO SUPPRESSION (MAX DC COMPONENT)
1	mv/div	50 mv(±25mv E.S.)	50 mv	500 mv
2	mv/div	100 mv(±50mv E.S.)	100 mv	1 volt
0	mv/div	500 mv(±250mv E.S.)	500 mv	5 volts
0	mv/div	1 volt(±500mv E.S.)	1 volt	10 volts
1	volt/div	5 volts(±2.5v E.S.)	5 volts	50 volts
2	volt/div	10 volts(±5v E.S.)	10 volts	100 volts
1	volt/div	50 volts(±25v E.S.)	50 volts	450 volts MAX (4.5 turns)
2	volts/div	100 volts (±50v E.S.)	100 volts	400 volts MAX (4.0 turns)

How to use Zero Suppression table

Examples:

35 mv peak-to-peak AC component riding on +750 mv DC level:

Function Switch: 2 mv/div position

Zero Suppress Switch: + position

Zero Suppress Dial: 7.50 turns(7.5 turns @100 mv/turn: 750 mv)

Recorded Signal Amplitude: 17.5 chart divisions peak-to-peak

2.0 volt peak-to-peak AC component riding on -40 volt DC level:

Function Switch: 0.1 v/div position

Zero Suppress Switch: - position

Zero Suppress Dial: 8.0 turns (8.0 turns @5 v/turn: 40 V)

Recorded Signal Amplitude: 20 chart divisions peak-to-peak

IV. PRINCIPLES OF OPERATION

A. Introduction

The Model TSC-901 Signal Conditioner controls the input signal and the stylus in the particular channel that it is used in the recorder.

1. Model TSC-901

The Model TSC-901 Signal Conditioner Module has a DC gain of ten (10) and a balanced differential input. This yields a system sensitivity of 1 mv/div. The balanced input attenuator shows a constant impedance of 500 K ohms to each input. Steps 4 through 11 on the attenuator switch, labelled V/DIV & MV/DIV, provide selectable signal input attenuation. Note that the TSC-901 has inputs marked "+" and "-" on the schematic. A positive signal applied to the "+" input causes the stylus to move to the right. A positive signal applied to the "-" input causes the stylus to move to the left. The Model TSC-901 features zero suppression.

B. Signal Input

The Module signal input presents a constant 500 K load to the signal through nine positions located on positions 3 through 11 of the function switch. The signal, referenced against common, passes through R7 to diodes CR2 and CR3, which limit signal voltage to a safe value to avoid severe accidental overload at the input of the attenuator. If an overload occurred, the excessive signal voltage would be dropped across R7.

Q1, the input pair, presents a very high 30 to 50 megohms load to the input attenuator, to keep attenuator loading to a minimum, and to maintain accurate attenuator ratios. This circuit portion,(Q1, R4, R6, R8, R9) has a voltage gain of unity. R9 maintains a zero-input zero-output condition. R4 reduces the Io leakage from the first transistor in Q1 to a level which causes less than 0.2 division of stylus shift when fully rotating the function switch. The Io flow would produce a false signal at the input of Q1 which would vary between 1 K and 500 K ohms as the function switch is fully rotated.

C. Power Supply (Model TSC-901

The center-tapped secondary of a power transformer feeds full-wave rectifier bridge module CR5 whose outputs yield a positive and a negative voltage with respect to the power transformer center tap. These raw DC outputs are smoothed by C5 and C6 and then pass to VR3 and VR4.The positive voltage regulator, VR3 is 15 volts $\pm$5%. The negative voltage regulator VR4 is -15 volts $\pm$5%. Capacitors C7 and C8 are used to insure that VR3 and VR4 do not oscillate.

D. Signal Input Zero Suppression Circuit (Dwgs.
Model TSC-901

Function switch S2 has two active decks, S2A and S2B. The S2B selector feeds the non-inverting input and the S2A selector feeds the inverting input of the module preamplifier section.

E. Input Protection Circuit (Dwg. 403640)

The input protection circuit, R7, CR3 and CR4 are the non-inverting input of the module preamplifier section. Diodes CR1 and CR3 are connected across the + and - inputs of the preamplifier and are back-biased at -7.5 volts through the voltage dividers R11 and R10. Diodes CR2 and CR4 connect the + and - preamplifier inputs and are similarly biased at +7.5 volts. Any input voltage above +8.0 volts will be shunted to common. Excess signal levels above 8.0 volts will be dropped across R4 and/or R7.

F. Input Matching Circuit & Io Adjustment

Input pair Q1 for a pair of emitter followers which present a very high input impedance. The Q1 collectors connect to the +15.0 VDC regulated supply and the emitters connect through their load resistors R12 and R13 to the -15.0 VDC regulated supply of the module. The effective input impedance at both Q1 bases equals the value of R12 or R13 multiplied by the current gain of its associated transistor in Q1. Since the current gain of Q1 lies in the range of 100 to 250K ohms, and R12 and R13 have a resistance of 500K ohms, the input impedance at the Q1 bases will be 50 to 125 megohms. The Q1 outputs are limited in amplitude by CR1 and CR4 to approximately $\pm$8 volts referenced to common.

Io adjustment potentiometer reduces the Io leakage currents from Q1 bases to a minimum, or to where Io leakage is the same from each base. Otherwise, this unbalanced current leakage from the bases would appear as a deflection of the recorder stylus where no input signal is present. Io control, R1, R2 and R5, balances current flow into the bases of Q1 through R3 and R6.

G. Voltage Gain Stage

The gain of the integrated operational amplifier A1 is set by the value of R17 (Rf) and R14 (Rs) by the ratio Rf/Rs. In this case, Rf = 100 K ohms, and Rs = 100 K ohms, yielding a DC gain of 1. R18 and R15 match R17 and R15 in value to present a balanced load to the outputs of Q1. The gain of A2 is the ratio of R22 to R19 which is 10. R24 adjusts the operational amplifier for zero output with zero input. R16, C1, C2, R21, C3, and C4 are used for frequency compensation. R34 and R29 are necessary to prevent "latch-up" of the operational amplifiers.

H. Stylus Position Control Circuit

The stylus position control potentiometer connects between the +15.0 and -15.0 V busses on the PC board. The slider of this control connects to the position input of the integrated amplifier pen motor.

I. Gain Control Circuit

The gain control potentiometer connects the output of A2 and the PC board common. Since the sensitivity of the pen motor servo amplifier is equal to approximately 8 mv/div., and since the preamp has a gain of ten, the rated sensitivity of the system (1 mv/div. is attained when the slider is at 75% of its full scale (270°) rotation. This slider is connected directly to the signal input lead of the integrated amplifier pen motor.

J. Calibration Circuit

Model TSC-901

The calibration voltage circuit comprises VR1, R25, R26, R27, and R28. VR1 is connected to the positive side of the regulated supply through R25. The regulated voltage of VR1 is divided down to the 200 millivolt level in the divider string R26, R27 and R28. The output of R2 is adjustable about 200 millivolts. This voltage is divided at the function switch by a further factor of 10, and the resultant 20 millivolts is made available for calibration at position number 3 of the function switch.

V. PREVENTIVE MAINTENANCE

A. Periodic Maintenance - Mechanical Check

These TSC checks are generally recommended every 500 hours of operation or every three to six months, as determined by experience. They may also be used for preliminary troubleshooting; but because of the mercury battery used in the zero suppression circuit, the battery and zero suppression voltage should be checked whenever the unit is being calibrated. See Section 1 Specifications.

1. Preliminary

Turn OFF all power to the recorder. Remove the signal conditioner by grasping the top and bottom black knobs and then pulling the signal conditioner straight out.

2. Cleaning

Blow out dust and dirt with an air hose. Inspect for foreign particles. Clean the preamplifier panel and knobs with a moist cloth, then wipe dry with a soft, dry cloth. Occasionally rotate each knob through its full scale. This keeps all contacts clean.

3. Inspect for Tightness

Inspect the signal conditioner and power supply for loose transistors, plug-in components, resistors, capacitors, controls, terminal boards, mounting boards, rectifiers, fuses, transformers, etc. Check that all panel-mounted components are securely in place, that all locking controls will lock securely, and that each knob is tight on its shaft.

4. Inspect for Damage

Inspect visually and by smell for burned or worn insulation, leakage, or damaged resistors, capacitors, transformers, etc. Inspect also for corrosion, rust, and electrical or mechanical abuse.

5. Replace

Reinstall the equipment and fasten securely.

VII. PARTS LIST - Model TSC-901

Ref. Desg.	Find No.	Quan. Req.	Part No. Or Identifying No.	Description
	1	1	403641	P.C. Board
	2	1	104305	Spacer, Transistor
	3	2	111010	Heat Sink
A1, A2	4	2	104296-1	Amp., I.C. 709
Q1	5	1	104297	Dual Trans. 2N4045
VR3	6	1	110016	Regulator 78M15UC
VR3	7	1	110017	Regulator 79M15UC
C1, C3	8	2	100484-332	Capacitor, Disc. 3300 PF
C2, C4	9	2	100484-201	Capacitor, Disc. 200 PF
C5, C6	10	2	110565-16	Cap. Electrolytic, 40V, 1000 MF
CR1-CR4	11	4	2-101971	Diode IN457
VR1, VR2	12	2	104154	Diode, Zener, 9V, 1N935
C7, C8	13	2	107128-106	Cap., Tant., 10uF
CR5	14	1	106080-2	Rectifier, Bridge
R1, R24	15	2	103954-503	Potentiometer, 50K
R27	16	1	103954-501	Potentiometer, 500Ω
R3, R6	17	2	101880-307	Resistor, Carbon, ½W, 300 M
R2, R5	18	2	100549-1002	Resistor, M.F., ¼W, 10 K
R12, R13	19	2	100549-4993	Resistor, M.F., ¼W, 499 K
R19, R20	20	2	100549-1003	Resistor, M.F., ¼W, 100 K
R22	21	1	100549-1004	Resistor, M.F., ¼W, 1 M
R23	22	1	100549-2493	Resistor, M.F., ¼W, 249 K
R25	23	1	100549-698R	Resistor, M.F., ¼W, 698Ω
R26	24	1	100549-5112	Resistor, M.F., ¼W, 51.1 K
R33	25	1	100549-1541	Resistor, M.F., ¼W, 1.54 K
R28	26	1	100549-1001	Resistor, M.F., ¼W, 1 K
R29, R34	27	2	100549-100R	Resistor, M.F., ¼W, 100Ω
R30, R31	28	2	100549-510R	Resistor, M.F., ¼W, 510Ω
R32	29	1	100549-2002	Resistor, M.F., ¼W, 20 K
R14, R15	30	2	1-100549	Resistor, Matched Pair, 100 K
R17, R18	31	2	1-100549-1003	Resistor, Matched Pair, 100 K
R16, R21	32	2	100556-302	Resistor, Comp., ¼W 3.0 K
R8, 9,10,11	33	4	100556-512	Resistor, Comp., ¼W 5.1 K
J1	34	A/4		Wire & Sleeving
R4, R7	35	2	100550-1003	Resistor, M.F., ½W, 100 K
REF.	36		403640	Schematic
R36	37	1	110555-9	Potentiometer 5 K

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	REDRAWN	10-1-69	
	B	REVISED PER WR[illegible] UPPRINT	4-21-[illegible]	20172

TP11 (P) +E

R23 10 50K
R25 10K
R14 300M
R18 10K
R21 5.1K
R20 5.1K
R15 100K
TP8 + INPUT
D1 D2 IN457
R24 300M
D4 D3
TP9 - INPUT
R16 100K
R19 5.1K
R22 5.1K
Q1
R12 100K
R9 100K
R10 499K
R11 499K
R7 1MEG.
AR1
3300PF C2
R6 3K
C1 200PF
R13 250K
R8 1MEG.
R17 50K VO
R5 100Ω
TP6
R3 698Ω
R4 51.1K
CR1 9V
R2 500Ω
TP2 CAL
R1 1K
C.W. GAIN ADJ.
20K REF.
TP4 (B) OUTPUT
(H) COM (TRANS.)
TP7 (F) COM. (SIGN.)
TP10 (N) -E
C.W. POS. ADJ.
TP3 (A) POS. OUT

REAR INPUT TP1 OPTIONAL
(D) +
(E) - TP5

(R)
(S)
CR4
Q3 2N4922
R27 150Ω
C3 53 OUF
CR3 16V
CR2 16V
C4 53OUF
R26 150Ω
Q2 2N4919

JUN 9 1983

DWG SIZE	CODE IDENT	SPECIFICATIONS		QUAN REQ	FIND NO.	PART NO. OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST							

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± 1/64 | TWO PLACE DECIMALS ± .010
ANGLES ± 1° | THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES. DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING. .63 MACHINE SURFACES TO BE √ RMS.
MATERIAL

DRAWN BY: C.W. HALL DATE 10-1-69
CHECKED BY: J.F. CAYER 11 OCT 69
CONTRACTOR CERTIFICATION:
DESIGN APPROVAL:
DOCUMENTATION APPROVAL:

Gulton techni-rite® INCORPORATED ELECTRONICS

SCHEMATIC PRE-AMP. (TSC-801)

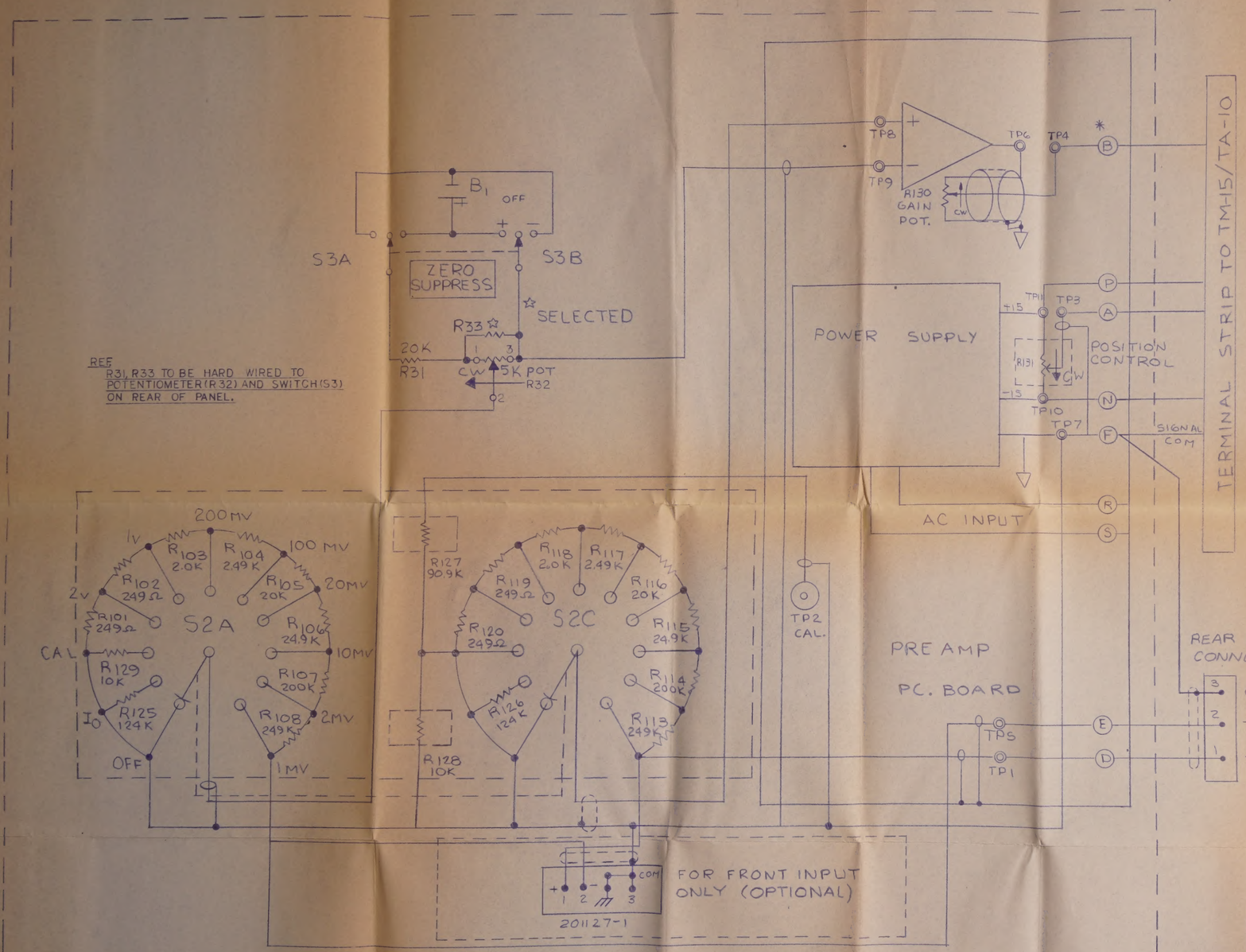
SIZE	CODE IDENT	DWG NO.
C	20	401064

SCALE NONE | CONTRACT NO. | SHEET 1 OF 1

DWG SIZE	NEXT ASSY	USED ON
C	401110	TSC-801
	APPLICATION	

AP 176

LTR	DESCRIPTION	DATE	APPROVED
A	REDRAWN	12-3-79	32566
B	REV. PER MKD. PRT.	10-19-79	43803



PREAMP MODULE

*CORRESPONDING TO P.C. CONNECTOR PIN

REF. DESG.	FIND NO.	QUAN REQ	PART NO. OR IDENTIFYING NO.	DESCRIPTION
PARTS LIST				

401133	TSC-801
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES:
FRACTIONS ± 1/64 | TWO PLACE DECIMALS ± .010
ANGLES ± 1° | THREE PLACE DECIMALS ± .005
REMOVE ALL BURRS AND SHARP EDGES. DIMENSIONS AND TOLERANCES SHALL BE HELD AFTER PLATING. MACHINE SURFACES TO BE 63 RMS.
MATERIAL:
FINISH:

DRAWN BY: S. KAZARIAS
DATE: 9/30/69 DR. 12-3-79
CHECKED BY: J.F. CAYER
DATE: 1 OCT 69
CONTRACTOR CERTIFICATION:
DATE:
DESIGN APPROVAL:
DATE:
DOCUMENTATION APPROVAL:
DATE:

JUN 8 1983

Gulton Industries Inc.

SCHEMATIC MODULE
PRE-AMP

CODE IDENT	SIZE	DWG NO.	SCALE	CONTRACT NO.	SHEET
70	D	600766	—		1 OF 1

PAP-177

Measurement & Control System Division
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